Inspection Selection System (ISS) for Compliance Safety Accountability (CSA)

ISS-2010 Algorithm Description



This document describes the Inspection Selection System (ISS) 2010 algorithm (ISS-2010), including the Federal Motor Carrier Safety Administration's (FMCSA) rationale for how and why ISS-2010 prioritizes carriers as it does. Appendix A describes, in detail, the calculations that result in ISS-2010 inspection values. In December 2010, ISS-2010 will replace ISS-D, which currently generates inspection recommendations and values in the ISS application used by roadside inspectors to identify and select carriers for inspection.

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ISS-2010Algorithm Description

Introduction

Federal Motor Carrier Safety Administration's (FMCSA) Inspection Selection System (ISS) is used at roadside inspection stations to help inspectors identify and prioritize motor carriers for safety inspections. In a further effort to improve large truck and bus safety, and ultimately reduce commercial motor vehicle (CMV) crashes as part of the Compliance Safety Accountability (CSA) Initiative, FMCSA is replacing the current algorithm that ISS employs to select motor carriers for inspection, called ISS-D, with a new algorithm, ISS-2010. Like ISS-D, ISS-2010 assigns an inspection recommendation of 'Inspect', 'Pass' or 'Optional' and ISS inspection value between one and 100 for every motor carrier in the FMCSA's Motor Carrier Management Information System (MCMIS).

Figure 1. ISS-2010 Inspection Recommendation and Inspection Value

Recommendation	ISS Inspection Value
Inspect (inspection warranted – top priority)	75-100
Optional (inspection warranted – next level priority)	50-74
Pass (inspection not warranted)	1-49

ISS-2010 prioritizes carriers by assigning inspection recommendations and inspection values based, in part, on a carrier's Behavior Analysis Safety Improvement Categories (BASIC) percentile values from the FMCSA's new CSA Safety Measurement System (SMS); this is similar to the way ISS-D used Safety Evaluation Area (SEA) values from SafeStat to generate inspection recommendations and values.

Because ISS-2010 uses BASIC percentiles from SMS, that system is described briefly below: SMS uses a motor carrier's data from roadside inspections and State-reported crashes in the last 24 months along with the Federal Motor Carrier Census data to quantify safety performance in the following BASICs:

- Unsafe Driving Parts 392 and 397 of the Federal Motor Carrier Safety Regulations (FMCSRs)
- Fatigued Driving (Hours of Service) (FMCSR Parts 392 and 395)
- Driver Fitness (FMCSR Parts 383 and 391)
- Controlled Substances/Alcohol (FMCSR Parts 382 and 392)

- Vehicle Maintenance (FMCSR Parts 393 and 396)
- Cargo-Related (FMCSR Parts 392, 393, 397, and HM Violations)
- Crash Indicator Histories or patterns of high crash involvement, including frequency and severity, based on information from State-reported crashes.

After a carrier's measurement is determined in each BASIC, the carrier is placed in a safety event group (e.g., with other carriers having similar numbers of inspections). Percentile ranking from 0 to 100 in each BASIC is determined by comparing the BASIC measurements of the carrier to the measurements of other carriers in the safety event group. A percentile of 100 indicates the worst performance. Percentiles are assigned only to a BASIC when the carrier has met data sufficiency standards as outlined in the methodology document referenced below, which describes BASIC calculations in detail:

http://csa2010.fmcsa.dot.gov/Documents/SMSMethodology.pdf

ISS-2010 has two parts: a **Safety Algorithm** and an **Insufficient Data Algorithm**.

- ISS-2010 Safety Algorithm prioritizes carriers by assigning an inspection recommendation and value to carriers with sufficient data to receive a percentile ranking in FMCSA's SMS. Additionally, the safety algorithm assigns an inspection recommendation and value to carriers where a Safety Investigator (SI) has found a serious violation during an investigation in the preceding 12 months. The Safety Algorithm assigns inspection recommendations of 'Inspect', 'Optional' or 'Pass.'
- ISS-2010 Insufficient Data Algorithm assesses all other carriers that were not assessed by the aforementioned Safety Algorithm. The Insufficient Data Algorithm assigns inspection recommendations of 'Inspect' or 'Optional.'

The ISS-2010 Safety and Insufficient Data Algorithms are described in more detail below. A description of the underlying calculations is attached in Appendix A.

ISS-2010 Safety Algorithm

The ISS-2010 Safety Algorithm uses the results of FMCSA's SMS and the presence of "serious violations" found in investigations to assign an inspection recommendation and calculate an ISS inspection value. More specifically, the ISS-2010 Safety Algorithm looks at SMS BASICs that may be in alert status, the number of alerts, and whether or not a safety investigator found any serious violations during investigations in the preceding 12 months. BASICs in alert status are defined by either: 1) SMS percentile value above FMCSA's threshold for identifying carriers that may merit intervention or 2) the presence of a serious violation found in an investigation, including a traditional Compliance Review or CSA onsite or offsite investigation, within the last 12 months.

These serious violations include:

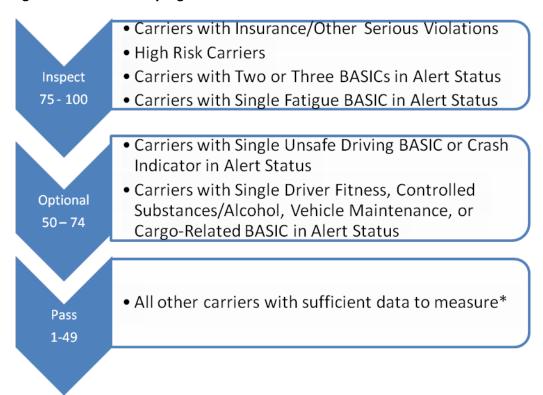
- Violations where noncompliance is so severe that they require immediate corrective action regardless of a carrier's overall safety performance. (A one-time occurrence, for example, failing to implement an alcohol or controlled substance policy)
- Violations that relate directly to a carrier's management or operational controls and indicate a breakdown in a carrier's management controls. (A pattern of violations, for example, false reports of records of duty status)

By including carriers with serious violations, ISS-2010 alerts the roadside inspection community to serious compliance problems and enables the Agency to monitor improvement. For a complete list of all serious violations, go to the CSA website:

http://csa2010.fmcsa.dot.gov/outreach.aspx (click on "Investigation Findings Serious Violations" under Fact Sheets and Brochures).

The figure below summarizes how the ISS Safety Algorithm prioritizes carriers; each category, Inspect, Optional and Pass, will be discussed below:

Figure 2. ISS-2010 Safety Algorithm Prioritization



^{*}Carriers without sufficient data to measure in SMS or a serious violation are prioritized using the Insufficient Data Algorithm

Inspect

As depicted above, the ISS Safety Algorithm recommends 'Inspect' for the following types of carriers and prioritizes within the inspect group in the order listed below:

- Carriers with Insurance/Other Serious Violations
- High Risk Carriers
- Carriers with Two or Three BASICs in Alert Status
- Carriers with Single t Fatigued Driving (HOS) BASIC in Alert Status

The ISS Safety Algorithm also ranks carriers within each subgroup by the sum of their BASIC percentiles, where the presence of a serious violation in a BASIC sets the percentile to 100, with the highest sum having the highest position. A brief description of each subgroup and the rationale for its place in the ISS-2010 prioritization scheme follows.

Carriers with insurance/other serious violations

The ISS-2010 Safety Algorithm places any carrier with Insurance/Other serious violations found in an investigation, including a traditional Compliance Review or CSA onsite or offsite investigation within the last 12 months, at the top of the 'Inspect' category. Example Insurance/Other serious violations include: operating a commercial motor vehicle without the minimum level of financial responsibility (one-time occurrence) and failing to maintain copies of accident reports (pattern of violations).

Carriers with serious violations relating to insurance/other are the highest priority because these carriers have, in the last 12 months, been found either in violation of regulatory requirements that are important pre-conditions for verifiably safe, responsible operation or to have falsified documentation required for entry. By identifying these carriers as 'Inspect' and putting them at the top of FMCSA's priority list, ISS-2010 enables the roadside inspector to confirm that the carrier, though recently out of compliance, has restored compliance in these important areas.

High Risk Carriers

FMCSA has identified a class of carriers as "High Risk" to fulfill its Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) mandate to "ensure that compliance reviews are completed on motor carriers that have demonstrated through performance data that they pose the highest safety risk (Section 4138)." FMCSA developed a new way of identifying high risk carriers as part of CSA; high risk carriers have the following characteristics that are based on roadside SMS performance only:

Four or more BASICs in alert status; or

 Both of the following: A) two or more total BASICs in alert status and B) one of those BASICs in alert status is in Unsafe Driving, Fatigued Driving (HOS), or Crash Indicator with BASIC percentile >= 85.

The ISS-2010 Safety Algorithm recommends 'Inspect' for high risk carriers. In doing so, ISS-2010 fosters consistent prioritization of carriers in both the roadside inspection and enforcement programs, and helps FMCSA and its State Partners fulfill this important Congressional mandate.

Carrier with two or three BASICs in alert status

The ISS-2010 Safety Algorithm also recommends 'Inspect' for carriers that do not meet the "High Risk" definition, but that have two or three BASICs in alert status. By doing so, ISS-2010 alerts roadside inspectors to carriers with broad, demonstrated compliance problems.

Carriers in alert status for a single fatigued driving (hours-of-service) BASIC

Finally, the ISS-2010 Safety Algorithm identifies carriers with a single Fatigued Driving (HOS) BASIC alert status as 'Inspect.' This BASIC is described below:

 Fatigued Driving (HOS) - includes operation of CMVs by drivers who are ill, fatigued, or in noncompliance with the hours of service (HOS) regulations. (FMCSR Parts 392 and 395)

Violations of FMCSA's hours of service regulation correlate highly with crash occurrence. By identifying these carriers as 'Inspect,' ISS-2010 enables roadside inspectors to take immediate action to prevent a fatigued driver from continuing to operate.

Optional

ISS-2010 assigns carriers with single BASIC in alert status, other than Fatigued Driving (HOS), an ISS value from 50 and 74. ISS-2010 places these carriers the 'Optional' category in the following order of priority:

- Carriers with Single Unsafe Driving or Crash Indicator BASIC in Alert Status
- Carriers with Single Driver Fitness, Controlled Substances and Alcohol, Vehicle Maintenance, or Cargo-Related BASIC

Again, carriers are ranked within each subgroup by the sum of their BASIC percentiles, where the presence of a "serious violation" in a BASIC sets the percentile to 100, with the highest sum having the highest position. It is important to remember that 'Optional' carriers are merely at a lower place on the priority list for inspection than 'Inspect' carriers. If resources are available to complete an inspection, these carriers possess demonstrated compliance issues based on roadside inspection results or higher than average crash involvement.

Carriers in alert status for a single unsafe driving BASIC and crash indicator

The ISS-2010 Safety Algorithm places carriers with single Unsafe Driving BASIC and Crash Indicator at the top of the 'Optional' category; this BASIC and indicator possess a stronger correlation with crashes than the remaining single BASICs based on analyses conducted when developing SMS. High-level description of this BASIC and indicator follows:

- Unsafe Driving Operation of CMVs by drivers in a dangerous or careless manner. Parts
 392 and 397 of the Federal Motor Carrier Safety Regulations (FMCSR)
- *Crash Indicator* Histories or patterns of high crash involvement, including frequency and severity, based on information from state-reported crashes.

Carriers in alert status for any remaining single BASIC: Driver Fitness, Controlled Substance/Alcohol, Vehicle Maintenance, Cargo-Related Additionally, the ISS-2010 Safety Algorithm places carriers with any remaining single BASIC in alert status in the 'Optional' category. These BASICs are described below:

- *Driver Fitness* Operating CMVs while being unfit due to lack of training, experience, or medical qualifications. (FMCSR Parts 383 and 391)
- Controlled Substances/Alcohol Operating CMVs while being impaired due to alcohol, illegal drugs, or misuse of prescription or over-the-counter medications. (FMCSR Parts 382 and 392)
- Vehicle Maintenance Failure to properly maintain a CMV. (FMCSR Parts 393 and 396)
- Cargo-Related Failure to properly prevent shifting loads, spilled or dropped cargo, overloading, or unsafe handling of hazardous materials on a CMV. (FMCSR Parts 392, 393, 397, and HM Violations)

Pass

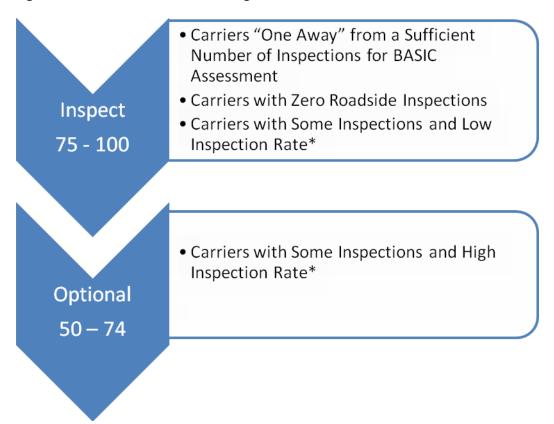
The ISS-2010 Safety Algorithm recommends 'Pass' for each remaining carrier that meets the data sufficiency conditions - number of inspections or crashes in a BASIC - but that shows no BASICs in alert status. These carriers are given a percentile rank in Fatigued Driving (HOS), Driver Fitness, Controlled Substances/Alcohol, Vehicle Maintenance, and Cargo-Related BASICs based on Pass carriers.. The carriers are then ranked based on the sum of the BASIC percentiles. The highest sum is assigned an ISS value of 49, and the lowest is assigned a one.

ISS-2010 Insufficient Data Algorithm

The ISS Insufficient Data Algorithm prioritizes carriers by determining the inspection recommendation and value for the remaining carriers not assigned an inspection

recommendation or value by the ISS-2010 *Safety* Algorithm. The underlying concept is to encourage inspections when there is little or no recent inspection or crash activity. Additionally, for carriers that are one inspection away from meeting the data sufficiency requirement for the SMS, ISS-2010 Insufficient Data Algorithm recommends 'Inspect', with the highest inspection values assigned to carriers with the highest violation rates. Figure 2, below, depicts how the ISS-2010 Insufficient Data Algorithm prioritizes carriers; both categories, 'Inspect' and 'Optional' will be described below.

Figure 3. ISS-2010 Insufficient Data Algorithm Prioritization



^{*}Inspection rate based on number of inspections per power unit and driver

Inspect

Carriers "one away" from a sufficient number of inspections for BASIC assessment

The ISS-2010 Insufficient Data Algorithm places carriers that are one inspection away from the minimum number of inspections to receive a BASIC percentile value in the 'Inspect' category and prioritizes them based on the violation rate of their previous inspections. Higher violation rates yield higher priority. These carriers receive the highest inspection values of those evaluated using the ISS-2010 Insufficient Data Algorithm.

Carriers with zero roadside inspections

The ISS-2010 Insufficient Data Algorithm also recommends 'Inspect' for carriers with no roadside inspections and prioritizes them based on their relative lack of exposure – carriers with more power units or drivers are prioritized above carriers with fewer.

Inspect/Optional

Carriers with some inspections (but not "one away")

Finally, the ISS-2010 Insufficient Data Algorithm recommends 'Inspect' or 'Optional' for carriers with some inspections. These carriers are prioritized based on their average carrier and driver inspection rate over the past two years with lower inspection rates receiving higher priority for inspection.

ISS-2010 generates inspection recommendations and values based on SMS, which FMCSA will use to replace SafeStat in December of 2010. The description above should help clarify in non-technical language how and why the algorithm prioritizes carriers as it does. The attached Appendix A describes these calculations in more detail and should serve to clarify the algorithm for individuals responsible for making changes to information systems that incorporate ISS-2010.

The Inspection Selection System (ISS) is a decision-aid for commercial vehicle/driver safety inspections which guides safety inspectors in selecting vehicles for inspection. The ISS provides a three tiered recommendation as follows:

Recommendation	ISS Inspection Value		
Inspect (inspection warranted – top priority)	75-100		
Optional (inspection warranted – next level priority)	50-74		
Pass (inspection not warranted)	1-49		

Note that the above recommendations are simply guidelines. The ISS value is on a continuous 1 to 100 scale, so for example, a carrier with a value of 98 would be recommended for inspection over a carrier with a value of 97, etc.

For carriers with a sufficient amount of data, the underlying ISS inspection value is based on data analysis of the motor carrier's safety performance record using information from FMCSA's Motor Carrier Management Information System (MCMIS). This **safety algorithm** for assigning the inspection value is described in the next pages. It is based on the CSA 2010 Safety Measurement System (SMS) and the discovery of a serious violation in the preceding 12 months. The SMS utilizes the previous two years of roadside violation and crash data and provides an assessment in seven safety behavior areas, called BASICs (Behavioral Analysis and Safety Improvement Categories). ¹

In the case of motor carriers for which there is not a sufficient amount of data, the ISS determines the inspection value by weighing the carrier size and number of past inspections in the past two years. This is called the **insufficient data algorithm** and is also explained in detail in the following pages. The underlying concept is to encourage inspections when there is little carrier history or past inspections. In addition, when a carrier is one (1) inspection away from meeting the data sufficiency requirement for the SMS, they are recommended for inspection, with the highest inspection values assigned to carriers with 100% violation rates. Except for this case, as the inspection data increases, the inspection value decreases. Eventually the carrier will receive enough inspections to be monitored via safety performance.

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¹ For a full description of the SMS, refer to the CSA 2010 web site at: http://csa2010.fmcsa.dot.gov/

In ISS, all active motor carriers have an inspection value. When the inspection value is displayed, either in the ISS software application or in Query Central, there is an accompanying message that states whether the inspection value is based on safety data or lack of safety performance data.

As an application, ISS also provides a great deal of current carrier specific information which is easily accessed by US DOT number, MC/MX number, State number, or carrier legal or DBA name. ISS also works with intrastate carriers who have been assigned a US DOT number or if states supply the carrier data.

The ISS-2010 Safety Algorithm

The Safety Algorithm for ISS-2010 is calculated as follows.

- 1. If during an intervention in the prior 12 months the carrier was found to have a serious violation, then the associated BASIC value for that violation is set to 100 before continuing the below calculations. If there is no associated BASIC for the violation, then the final ISS-2010 inspection value is set to 100. This condition does not apply to the High Risk carriers defined by 2a below.
- 2. Identify if the carrier meets any of the following criteria. Note that each carrier with enough safety performance data will fall into one unique group [2a-2f].
 - a. High Risk four (4) or more SMS BASIC percentiles above the "general carrier" intervention thresholds; OR two or more SMS BASIC percentiles above the "general carrier" intervention thresholds AND one of those SMS BASIC percentiles is in Unsafe Driving, Fatigued Driving, or Crash Indicator with the BASIC percentile >= 85
 - b. Two or three BASIC percentiles in alert status (for carriers who do not fall into (a) above)
 - c. Single Fatigued Driving BASIC percentile in alert status
 - d. Single Unsafe Driving or Crash Indicator BASIC percentile in alert status
 - e. Single Driver Fitness, Controlled Substances and Alcohol, Vehicle Maintenance, or Cargo Related BASIC percentile in alert status
 - f. One or more BASIC percentiles, but none deficient OR has the minimum number of applicable inspections for a measure [e.g., five (5) vehicle inspections (Level I, II, V, or VI); or three (3) driver inspections (Level I, II, III, or VI)]
- 3. For carriers in groups 2a through 2c, sum their BASIC percentiles, rank this sum, and assign quantile values from 75 to 100. Note that carriers in group 2a are ranked higher than carriers in group 2b, and carriers in group 2b are ranked higher than carriers in group 2c.

- 4. For carriers in groups 2d and2e, sum their BASIC percentiles, rank this sum, and assign quantile values from 50 to 74. Note that carriers in group 2d are ranked higher than carriers in group 2e.
- 5. For carriers in group 2f:
 - a. If the carrier has three (3) or more driver inspections, use the Fatigued Driving BASIC measure²
 - b. If the carrier has five (5) or more driver inspections, use the Driver Fitness BASIC measure
 - c. If the carrier has three (3) or more driver inspections, use the Controlled Substances and Alcohol measure
 - d. If the carrier has five (5) or more vehicle inspections, use the Vehicle Maintenance BASIC measure
 - e. If the carrier has five (5) or more vehicle inspections, use the Cargo Related BASIC measure
 - f. Rank each of the five (5) applicable measures above by the associated safety event group for that measure, and assign percentiles to the ranks (1 to 100).
 - g. Sum the applicable measure percentiles for each carrier.
 - i. Note that values in the Unsafe Driving measure and/or the Crash Involvement measure are not included in this group as ANY value in these measures indicates a negative event occurred (e.g., carriers with values in these measures are always "less safe" than carriers with no values in these measures).
 - h. Rank the sums, and assign quantiles to the ranks of 1 to 49.
- 6. The quantile values from steps 3 through 5 then become the ISS-2010 Safety inspection values. Carriers in groups 2a through 2c receive values from 75 to 100; carriers in groups 2d and 2e receive values from 50 to 74; and carriers in group 2f receive values from 1 to 49.

² For a full description of these measures, refer to the CSA 2010 web site at: http://csa2010.fmcsa.dot.gov/

The ISS-2010 Insufficient Data Algorithm

The **Insufficient Data** Algorithm for ISS-2010 is calculated as follows.

For every carrier that does not receive an ISS-2010 Safety inspection value, they will receive an ISS-2010 Insufficient Data value based on the following algorithm. These values will always range from 50 to 100.

All data is based on the past 24 months.

Note that once a carrier meets the minimum number of applicable inspections for a measure (e.g., has five (5) Level I, II, V, or VI inspections; or has three (3) Level I, II, III, or VI inspections) their ISS-2010 Insufficient Data Value is set to 50.

Case 1: For carriers who are "1 away" from meeting the minimum number of applicable inspections for a measure (e.g., currently have four (4) Level I, II, V, or VI inspections; or currently have two (2) Level I, II, III, or VI inspections)

Calculate a **violation rate** for these carriers by dividing the total number of inspections with a violation by the number of inspections.

- 1. For carriers with four (4) Level I, II, V, or VI inspections;
 - a. if their violation rate is 100% then set their ISS-2010 Insufficient Data Values = 100
 - b. if their violation rate is 75% then set their ISS-2010 Insufficient Data Values = 99
 - c. if their violation rate is 50% then set their ISS-2010 Insufficient Data Values = 98
 - d. if their violation rate is 25% then set their ISS-2010 Insufficient Data Values = 97
 - e. if their violation rate is 0% then set their ISS-2010 Insufficient Data Values = 96
- 2. For carriers with two (2) Level I, II, III, or VI inspections;
 - a. if their violation rate is 100% then set their ISS-2010 Insufficient Data Values =
 - b. if their violation rate is 50% then set their ISS-2010 Insufficient Data Values = 98
 - c. if their violation rate is 0% then set their ISS-2010 Insufficient Data Values = 96

Case 2: If a carrier has zero (0) roadside inspections (Level I, II, III, or V, or VI), an ISS-2010 Insufficient Data value is assigned based only on their size as follows:

Category				ISS-2010 Value
1001+ power units	OR	1001+ drivers	=	95
201-1000 power units	OR	201-1000 drivers	=	94
64-200 power units	OR	72-200 drivers	=	93
16-63 power units	OR	16-71 drivers	=	92
7-15 power units	OR	6-15 drivers	=	91
2-6 power units	OR	2-5 drivers	=	90
1 power unit	OR	1 driver	=	89

- 1. The carrier is assigned the *higher* of their values. For example, if a carrier has 75 power units (ISS-2010 value = 93) and 50 drivers (ISS-2010 value = 92), they would receive a final ISS-2010 value of 93.
- 2. *If there is neither power unit information nor driver information,* the carrier is assigned the midpoint ISS value of 92.

Case 3: For carriers with one or more previous roadside inspections, but not enough to fall under Case 1, their Inspection per Power Unit Rate, their Inspection per Driver Rate, and subsequent Inspection Average Rate is determined as follows, ranked, and then assigned ISS-2010 values from 50 to 95.

- 1. The <u>Inspection per Power Unit Rate</u> is determined by dividing the number of <u>Level I, II, V, and VI</u> inspections the carrier has had in the previous 24 months by the number of power units they have.
- 2. The <u>Inspection per Driver Rate</u> is determined by dividing the number of <u>Level I, II, III, and VI</u> inspections the carrier has had in the previous 24 months by the number of drivers they have.
- 3. The **Inspection Average Rate** is then the average of these two rates (the Inspection per Power Unit Rate and the Inspection per Driver Rate). *If one of the rates is unable to be determined (because of no power unit or driver information), the Inspection Average Rate is simply the rate which can be determined.*

- 4. Using these Inspection Average Rates, a ranking and then quantile of 1 to 46 is calculated, and then added to 49; so that values of 50 to 95 are assigned to the carriers (the *lowest* Inspection Average Rates receive the highest values). This quantile value then becomes the carriers' ISS-2010 Insufficient Data value.
- 5. If there is no size information available to calculate the Inspection Average Rate (but, the carrier does have at least one inspection), the ISS-2010 Insufficient Data value is set to the value of 92.

Thus, ALL carriers have a Safety ISS-2010 value OR an Insufficient Data ISS-2010 value.